Evidence of Interdependence and Integration in Asian Banking Markets: An Analysis of Share Price Indices

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Abstract

Analysis of banking stock price index data confirms significant positive relationships between several major Asian regional banking systems and the Japanese banking system. Regression analysis of a split sample of unlagged data shows that these relationships have increased in strength during the period of the study. Results are confirmed when multivariate vector autoregressive based cointegration and variance decomposition analysis is undertaken. The findings are important because they illustrate that Asian banking systems have increased the pace and scope of regional financial integration following the South East Asian currency crisis. The larger developed Japanese banking market retains its prominent regional influence even though high levels of non-performing loans have been reported that will require substantial recapitalisation over the next decade. No doubt banks in the region will remain under the scrutiny of regulatory authorities. Closer regional trade and investment ties through free trade agreements may be part of the reason for the flow on from economic to financial integration.

Introduction

In the latter part of the 1990s, following the Asian currency crisis, the importance of Japanese banking global influence and financial health has declined substantially. However, Japanese banks still have a major function in providing finance for the large Japanese multinational corporations and loans to governments and corporations throughout Asia, in Latin America and in Europe. Whilst Japan has not significantly opened its domestic banking market, it has engaged in substantial foreign direct investment and direct lending into Asian and other banking systems (Hughes and MacDonald, 2002). The general view is that domestic economic factors have led to the current problems in Japanese banking, but these have been exacerbated with global crises such as the South East Asian currency crisis from mid 1997 to late 1999.

Japan suffered a serious recession in the late 1990s after a period of low economic growth, large fiscal deficits, burgeoning public sector debt, and numerous corporate failures. Within the banking system other problems emerged, such as the conflicting nexus between related corporations with cross company shareholdings within corporate groups and a poor credit and lending culture. The reforms in Japanese banking will be far-reaching and aimed at preventing contagion as well as at an acceleration and consolidation of financial restructuring (Hughes and MacDonald, 2002).

The Asian currency crisis and associated economic downturns began with the collapse of the Thai Baht in Mid 1997 and spread in a contagious way to affect primarily the Ringitt in Malaysia, the Peso in the Philippines, the Rupiah in Indonesia and then migrated to Korea to affect the Won. These events had a profound effect on Asian region economies and banking systems. Lesser effects were also found in adverse currency movements in regional developed economies, whose currencies were not tied directly to the US Dollar, such as Australia and Singapore.

The key issues in this paper are whether or not the degree of financial integration in the banking systems in Asia has increased after onset of the regional currency crisis in mid 1997 (The effects of the currency crisis continued to affect developed economies such

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as those of Australia, South Korea and Singapore well into 2001). In addition, the paper is concerned with whether or not the Japanese banking system remained the driver of or the major influence on the major Asian banking systems over the full period of the study. The first steps of formal economic integration have been taken through the Association of South East Asian Nations. The issue is whether or not there has been a flow on for financial integration of banking systems. These concerns are important in light of the well-reported and continuing problems of bad and doubtful debts in, and the imperative for recapitalisation of the Japanese banking system over the next decade.

Literature and Theory

Regional economic integration means "agreements among countries in a geographical region to reduce and ultimately remove tariff and non-tariff barriers to the free flow of goods, services and factors of production between each other" (Hill, 2003, pp. 232). The cases for regional integration are both economic and political in nature. The economic case is based on the argument that the unrestricted flow of trade will result in particular countries specialising in the production of goods and services that those countries can produce more efficiently. The end result is greater global trade, world production and economic growth. The political case rests on the premise that interdependence of economies will eventually lead to a reduction in global conflicts with improved political cooperation between neighbouring states. Individual countries may in due course be able to enhance their global political influence. These objectives are part of the official stance on global economic integration supported by the World Trade Organisation (Hill, 2003).

It follows that regional financial integration of banking markets is the removal of barriers to the free flow of banking services and factors of production, primarily capital, between banking systems within regions and globally. Integration implies that markets become more interdependent. Stock markets are important economic indicators. Banks are important economic agents. It is contended that the examination of country and regional banking stock price data will provide basic evidence of the degree of financial integration and interdependence of Asian banking systems.

There have been many studies that have investigated financial integration of stock markets. The studies have taken various forms, using different country and regional data, and different economic indicators, but each study reviewed for this paper has focussed on stock market information. For example, Fratzscher (2001) analysed the integration process of European equity markets since the 1980s and found that European equity markets have tended towards greater integration only since 1996. Moreover, the Euro market area has gained significantly in its importance in global financial markets having taken over from the US as the dominant market in Europe. The integration of European equity markets is in a large part explained by the drive towards the European Monetary Union (EMU). Brooks and Del Negro (2002) examined the relative importance of country and regional effects in the financial integration of international stock returns. They found overall that there is greater integration of stock markets across regions, but that Europe is the only region where industry effects are robustly more significant than country effects. Hunter (2004) examined equity markets of Argentina, Chile and Mexico to assess whether or not these markets had become more integrated during the post-liberalisation period. The evidence pointed to a trend towards segmentation rather than integration implying that the liberalisation of regional stock markets had not induced greater interdependence.

Soenen and Johnson (2005) used daily stock market returns from 1988 to 1998 to examine developed and Asian equity markets and whether or not they were integrated with Japan's equity market. Also investigated were factors affecting levels of financial integration. This study found that the equity markets of Australia, China, Hong Kong, Malaysia, New Zealand and Singapore were highly integrated with the Japanese stock market. Soenen and Johnson also found that the Asian markets studied above have tended to become more integrated over time, especially since 1994.

Yang, Kolari and Min (2005) investigated the long-run cointegrating relationships and short-term causal linkages between US, Japanese and ten emerging Asian

stock markets. Particular attention was directed at the South East Asian currency crisis period in 1997-1998. The motivation was to demonstrate how stock financial integration is affected by financial crises. The findings were that long and short-run relationships were strengthened during the crisis and the markets have tended to become more integrated after the crisis.

Several facts need to be considered in the analysis of Asian region stock markets. Questions need to be asked as to whether or not valid comparisons can be made between the banking systems, some of which are developed (For example Japan, Australia, South Korea, Hong Kong and Singapore) and others that are still developing (For example, China, Thailand, Malaysia, the Philippines, Taiwan and Indonesia).

The lack of informational efficiency and transparency of some developing and emerging markets in the Asian region makes it difficult to assess whether those banking systems have accurately risk weighted their assets for Tier 1 and Tier 2 capital and whether or not they have maintained appropriate levels of capital adequacy. Japan, as a developed banking system, has at least maintained minimum capital adequacy levels as prescribed by the various Basel Accords. However, although Japan is very much a part of the global banking market, it has not effectively opened its own banking market to foreigners.

The literature generally suggests that global integration and regional integration of Japanese and Asian stock markets is a reality and that the Japanese stock market is exogenous in the Asian region. The broad issues of this paper relate to whether or not such cointegration and causality is evident in Asian regional banking markets and if these relationships strengthened or weakened after the South East Asian currency crisis.

The specific questions to be addressed are as follows: What is the strength and direction of the relationship between unlagged banking stock price index data in Japan and those banking markets in the Asian region? In addition, using appropriately lagged banking stock price data; other issues are whether or not there is evidence of cointegrating relationships between the Japanese banking market and those of the major countries in the Asian region? If cointegration exists in level series price index values, does causality run both ways or does it run significantly from the Japanese market and to which markets? Is there a genuine threat of financial contagion in Japanese and the Asian region markets studied? What are the systemic banking regulatory policy implications for the Asian region?

The Model and Data

Level daily time series banking stock price index data were collected for each country in the sample from Datastream covering the period 31/12/1999 to 20/9/2004. The market model used is a simplified and adapted version of Sharpe's Capital Assets Pricing Model (Sharpe, 1964) as discussed and reported in Reilly and Brown (2003). Reilly and Brown feel that the analysis of indexed data is feasible in the study of risk/return relationships in stock markets, assuming the indices studied are representative.

For the purposes of this paper is that it is deemed important to test both unlagged and lagged data in a multiple linear regression and in a multivariate VAR respectively, because VAR tests are to be used to confirm the specification of the basic regression model. Moreover, the sample of time series data is split to compare differences in unlagged regression relationships for the period shortly after the Asian crisis (31/12/1999 to 31/12/2001) and for the period 31/12/2001 to 20/9/2004.

Regression analysis of unlagged level series data is also undertaken to show how the data behave. If the series and the regression errors are found to be non-stationary and are then found to be converted to stationarity after first differencing, the series and errors will be confirmed as integrated non-stationary processes. A vector autoregressive (VAR) model in optimally lagged level series data can then be used to test for cointegration, causality and variance decomposition.

The study commences with the specification of a basic pairwise market model to initially analyse unlagged price data as follows:

$$B_{i_t} = \alpha_t + \beta_t B_{j_t} + e_t \qquad (1)$$

Where:

B_{i_t} is the banking stock price index values (representing a country banking market) for country i at time t.

B_{j_t} is the banking stock price index values (representing a country banking market) for country j time t.

α_t, β_t and e_t are the regression intercepts, coefficients and error terms at time t, respectively.

Based on the Granger (1988) findings that financial and economic time series may contain unit roots and in the development of the theory of non-stationary time series analysis, the unlagged regression model is re specified to implement VAR based tests for both cointegration and causality in optimally lagged data.[2]

A pairwise VAR model is developed as follows:

$$B_{i_t} = a_1 B_{i_{t-1}} + \cdots a_n B_{i_{t-n}} + bB_{j_t} + e_t \qquad (2)$$

Where:

B_i is a vector of endogenous variables being bank stock price index values representing a country banking market) for country i at times t to $t - n$.

B_j is a vector of exogenous banking stock price index values (representing and country banking market) for country j at time t.

$a_1 \ldots, a_n$ and b are matrices of coefficients to be estimated.

e_t is the error term and specifically it represents a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right hand side variables.

The pairwise models in Equations 1 and 2 are expanded in this analysis to become multivariate models inclusive of all Asian banking markets in single regression and VAR models. The banking markets are proxied by banking stock price index values. Based on Equation 1, the Japanese market is treated as the dependent variable regressed on the markets of Indonesia, South Korea, Taiwan, Singapore, Thailand, the Philippines, Australia, Hong Kong, Malaysia and China.

Similarly, based on the Equation 2 VAR, the Japanese market is treated initially as the endogenous variable with VAR based Johansen cointegration, and Granger causality and variance decomposition tests then applied to confirm long-term relationships, interdependence, short-term dynamics and whether or not the Japanese market is exogenous.

Methodology and Preliminary Analysis

Jarque Bera test statistics revealed problems with skewness and kurtosis with each of the level price series. An initial drawback of the analysis is that none of the series is normally distributed, thus providing an initial indication of problems, such as serial correlation.

The low probabilities (Significance is at the 1% level) of the Chow breakpoint and forecast test F statistics and log likelihood ratios reveal structural breaks in the data. This may also detract from the results of the study. It is evident that the "9/11" terrorist attacks affected USA banking stock prices, which affected Japanese banking stock price values, with spillovers to other country banking systems.

The level series of prices and the errors of the linear combinations were found to be non-stationary in each case (except in the developing markets in Malaysia and Indonesia) when Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were applied. The ARCH tests revealed significant error term heteroskedasticity. The Q tests over 12 lags detected significant first order serial correlation in the errors indicating that the Equation 1 based multiple linear regression of level series price index values possessed spurious explanatory power.

First differencing converted the level series to stationarity (along with the errors of the linear combinations) and removed the problem of serial correlation in the errors of the regression, but the explanatory power of the models decreased. The ordinary least squares (OLS) regression was respecified into an autoregressive conditional heteroskedasticity (ARCH) model to account for heteroskedasticity of an unknown form.

[2]All data are analysed using the EViews4 (2001) statistical package.

Heteroskedasticity in the errors remained persistent as revealed by ARCH tests.

Both mean and variance equations were specified in an ARCH (2) model. Heteroskedasticity consistent variances were computed as it was suspected that the residuals were not conditionally normally distributed. One ARCH term and one GARCH term were estimated. The results of ARCH analysis are reported in Appendix /Table 1.

Then VAR based cointegration tests (Johansen tests) were implemented on the basis that stationary linear combinations may represent cointegrating equations and imply long-run equilibrium or stable relationships among the variables in the market model. Pairwise Granger causality tests were then undertaken followed by multivariate VAR based variance decomposition tests.

Variance decomposition separates the variation in endogenous variables into the component shocks to the VAR. It provides information about the relative importance of each random innovation (in the form of a one standard deviation shock) in affecting the variables in the VAR and confirms the various causal relationships when all variables are included in a single model. These results are reported in the following section.

The Findings

Regression analysis of unlagged data

The changed relationships of the Asian banking systems interacting with the Japanese system are indicated when ARCH models of first differenced prices are analysed for the two sample periods. The full results are shown in Appendix/Table 1. Levels of statistical significance are set at 10%. The adjusted R square value of the model over the first period (up to 31/12/2001) is 0.0467. For the second period (from 31/12/2001 to 20/9/2004) the adjusted R square value is 0.0976. The explanatory power of the model has almost doubled in the second period. It is clear that the pace of financial integration in Asia has increased significantly in recent years since the South East Asian currency crisis.

The significance of the Q test statistics in testing up to 12 lags revealed that that serial correlation in the errors of the linear combinations is no longer evident over both periods studied. With the specification of an ARCH (2) model the combined value of the ARCH and GARCH coefficients is positive over both periods studied.

Moreover, the significant explanatory variables in the first period are those for the banking systems of Hong Kong and Indonesia. However, in the second period the significant explanatory banking system variables included Hong Kong, Indonesia, Thailand, South Korea, Malaysia and Taiwan. This again indicates the increasing scope and pace of financial integration in the Asian region over the most recent years since the South East Asian currency crisis.

VAR based tests of lagged data

Stability, Lag Order Selection and Cointegration

Multivariate VAR models based on Equation 2 were then specified in order to test the level series prices for cointegration and causality over the full period of the study. The VAR condition stability tests on one through ten daily lags were undertaken and found stable. The VAR stability condition tests indicated that no root lay outside the unit circle (See Appendix Table 2). Maximum likelihood ratios (The maximum LR is the maximum sequential modified likelihood ratio test statistic.) and minimum information criteria (FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwartz information criterion and HQIC is the Hannan-Quinn information criterion for optimal lag determination.) were used to test the optimal lags with particular reliance on the AIC and FPE when the SIC and HQIC indicated shorter lag intervals. Patterson (2000) feels that the AIC is often used to determine the lag interval, because its finite sample performance in choosing the right lag interval is not necessarily inferior to SIC or HQIC. The lag order selected based on the FPE and AIC is 2 (See Appendix/Table 3).

Johansen tests were then applied for cointegration analysis. With the assumption of a linear deterministic trend, minimum trace statistics indicated two coin-

tegrating equations over the full period of the study at both the 5% and 1% levels of significance (Maximum eigenvalues indicated two cointegrating equations at the 5% level and one cointegrating equation at the 1% level). The results of the VAR Johansen tests are shown in Appendix/Table 4.

Causality and Variance Decomposition

Pairwise Granger causality tests were undertaken on a lag order of 2 with significance levels set at 10%. The significant results are shown in Appendix/Table 5 and show substantial interaction between the various Asian banking markets on a pairwise basis. The highest F statistics and the lowest probabilities determine the direction of causality (exogeneity). For example, on a pairwise basis, the Japanese banking system exerts significant influence over the Chinese, South Korean and the Philippines markets.

Australia exerts significant influence over the Chinese, South Korean, Philippines and Thai markets. The Hong Kong and Singapore banking markets also have strong influence over other Asian banking markets in the Philippines, Singapore, Thailand and Taiwan (Hong Kong) and in Indonesia, Thailand, Taiwan and Malaysia (Singapore). From these results it is noted that the developed Asian banking systems generally, have the greater influence over the less developed in the region. Thailand, Indonesia, Malaysia and Taiwan have an influence over a mixture of other developed and developing Asian banking systems with some evidence of dual causality.

All markets are then considered simultaneously in a single multivariate VAR model for variance decomposition analysis. The findings generally confirm the exogeneity of the Japanese banking system in bank stock price index values when all markets are considered together. The most important results are reported showing the proportion of self-explained variance of each endogenously treated variable, 10 days after a one standard deviation shock is delivered to that variable.

Ten days after the endogenous shock, the Japanese banking market explains 99.0608% of its own variance in price index values, the Chinese market explains 98.8897%, the Australian market 97.8469%, the Indonesian market 96.2833%, the Philippines market 92.4649%, the Hong Kong market 90.3200%, the Taiwan market 85.4751%, the Thailand market 84.4515%, the South Korean market 81.3034%, the Malaysian market 79.3487%, and the Singapore market 61.8042%.

The Japanese market is the major exogenous force 10 days after shocks are delivered to the Australian, Hong Kong and Indonesian markets. The Japanese market is the second strongest exogenous force 10 days after shocks are delivered to the Chinese and Philippines markets. It is significant that the Hong Kong banking system is the major exogenous force 10 days after shocks are delivered to the South Korean, Malaysian, Singaporean, Thailand and Taiwan markets. The Australian banking market also possesses significant exogeneity in respect to the Indonesian market. Developed banking systems in the region remain the most significant exogenous forces led by the banking system of Japan.

Conclusion

Previous studies have confirmed the growing pace of Asian stock market integration and the protagonist role of Japanese financial markets (For example, Soenen & Johnson, 2005; Yang, Kolari & Min, 2005). In this paper, analysis of Asian stock markets has extended to Asian banking markets by examining country banking stock price index values. The results demonstrate that the pace and scope of financial integration in the Asian region has increased following the South East Asian crisis. The explanatory power of the regression models in the second period is almost twice as much as that in the first period. In the second period there is a greater number of significant positive interactions (that is, more banking and markets become related to the Japanese market and to Hong Kong and Indonesian markets only in the first period).

The Asian banking markets are cointegrated and therefore demonstrate a degree of financial interdependence. The results indicate that the specified model is stable over the full period of the study and there are two cointegrating equations on an optimal lag order of two. Causality tests show that exogeneity ap-

pears to lie predominantly with the larger and more globally integrated Japanese market, which exerts significant influence over the Chinese, South Korean and Philippines markets. The Australian market exerts significant influence over these markets as well as the Thailand market. Overall, the developed Asian markets have a greater influence over the less developed markets.

The reasons promulgated for these results are as follows: Even though Japanese banks have declined in importance since the mid 1990s, they remain the largest and most globally interactive in the Asian region. Discussions among Japanese and Asian policy makers are leading to even closer Asian regional economic ties, as seen in the growing strength of the Association of South East Asian Nations and the Asia Pacific Economic Cooperation agreements. The future establishment of an Asian currency unit has also been discussed.

It is logical that these trends will include the Japanese banking system as a focal point. Competitive forces emanating from the European Union and other free trade areas, such as that covered by the North American Free Trade Agreement, may be hastening the Asian financial integration process. The continuing strength of the Yen, the recent strength of the Euro and the weakness of the US dollar during 2002 to 2005 may also be contributing factors to faster Asian financial integration.

More recently preliminary discussions have commenced concerning the possible amalgamation of the stock markets of Singapore, Malaysia, Indonesia, the Philippines and Thailand. Asian financial integration could also be enhanced by the existence of similar cultural backgrounds in most of the countries in the Asian region.

The liberalisation of Asian economies, post South East Asian currency crisis, is continuing and is probably helping to improve the pace of Asian banking and financial integration. The Asian banking markets do not have advanced formal agreements and regulations in place for banking integration. The European Union does have formal agreements in place for financial services integration and many of the systemic risks through interdependence have been diversified away in a well-regulated system, compliant with Basel Accord guidelines.

Asian regional economies (except for Japan, Australia, South Korea, Hong Kong, and Singapore) are in their development phase. The developing Asian banking markets are still addressing issues of capital adequacy and appropriate risk weighting of loan assets. No doubt the pace of Asian financial integration will gather as Japan opens up its banking market, as it restructures its banking industry and as the developing Asian economies implement faster macro and micro economic reforms.

Japan's influence as a regional banking centre has probably more to do with the relative size of its globally interactive banking system (that is, size in respect to market capitalisation) rather than the quality of its loan portfolios and banking practices. Whilst growing integration is consistent with World Trade Organisation guidelines on financial liberalisation, systemic risk spillover from the important Japanese market could occur in developing Asian regional banking systems unless issues such as diversification of the risks of interdependence and unless other issues relating to capital adequacy are properly addressed in each market. Japan itself must focus on the recapitalisation of its banking system over the next decade if it is to remain the regional banking powerhouse.

References

Brooks, R., and Del Negro, M., (2002), International Stock Returns and Financial integration: A Regional Perspective, *FRB of Atlanta Working Paper*, Number 2002/20, November, Research Department.

EViews 4 (2001), *EViews 4 User's Guide*, Quantitative Micro Software, LLC.

Fratzscher, M., (2001), Financial integration in Europe: On the Effects of EMU on Stock Markets, *ECB Working Paper*, Number 48, March.

Granger, C. W. J., (1988), Some Recent Developments in a Concept of Causality, *Journal of Econometrics*, Volume 39, 199-211.

Hill, C H., (2003), *International Business*, International Edition, McGraw Hill, New York, page. 232, 256-257.

Hughes, J E., and MacDonald, S B., (2002), *International Banking*, Addison Wesley, Boston, 417-420.

Hunter, D M, (2004), The Evolution of Stock Financial integration in the Post Liberalisation Period-A Look at Latin America, *Journal of International Money and Finance*, September (forthcoming), Social Science Electronic Publishing.

Patterson, K., (2000), *An Introduction to Applied Econometrics*, MacMillan Press, London, 239, 258-9.

Reilly, F K., and Brown, K C., 2003, *Investment Analysis: Portfolio Management*, Thomson South Western, Ohio, 247-250.

Sharpe, W F., 1964, Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance*, 19, No. 3, September, 425-442.

Soenen, L A., and Johnson, R., 2005, Asian Economic Integration and Stock Market Co movement, *Journal of Financial Research*, and Social Science Electronic Publishing ID 253292.

Yang, J., Kolari, J W., and Min, I., 2005, Stock Financial integration and Financial Crises, The Case of Asia, http://ssrn.com/abstract=318965.

Appendix

Table 1

Results of ARCH Regressions for the First and Second Sub-Samples in First Differenced Banking Stock Price Index Values

First Period

Dependent Variable: D(JAP)

First period sample (adjusted): 1/03/2000 12/31/2001
Included observations: 521 after adjusting endpoints
Convergence achieved after 49 iterations

	Coefficient	Std. Error	z-statistic	Prob.
D(HK)	0.0140	0.0044	3.1573	0.0016
D(INDON)	0.4104	0.1817	2.2583	0.0239
Variance Equation				
C	30.5108	4.9078	6.2169	0.0000
ARCH-GARCH	0.0070	0.0140	0.4987	0.0180
Adjusted R-squared	0.0467	S.D. dependent variance		6.0354
S.E. of regression	5.8927	Akaike information criterion		6.3949
Sum squared residual	17570.36	Schwarz criterion		6.5174
Log likelihood	-1650.87	Durbin-Watson		1.7997

Second period

Dependent Variable: D(JAP)

Second period sample: 12/31/2001 9/20/2004
Included observations: 711
Convergence achieved after 14 iterations

	Coefficient	Std. Error	z-statistic	Prob.
D(HK)	0.0090	0.0038	2.4064	0.0161
D(INDON)	0.4194	0.2227	1.8331	0.0597
D(KOREA)	0.3427	0.1076	3.1841	0.0015
D(MALAY)	0.0252	0.0143	1.7629	0.0779
D(THAI)	0.0721	0.0359	2.0059	0.0449
D(TAIWAN)	0.1264	0.0672	1.8804	0.0601
Variance Equation				
ARCH-GARCH	0.1114	0.0307	3.6235	0.0003
Adjusted R-squared	0.0976	S.D. dependent variance		4.1521
S.E. of regression	3.9442	Akaike information criterion		5.4225
Sum squared residual	10827.59	Schwarz criterion		5.5189
Log likelihood	-1912.71	Durbin-Watson		1.7456

Note: Significant values only are reported. D-parenthesis denotes first differences in banking stock price index values for Australia (Austral), China (China), Hong Kong (HK), Indonesia (Indon), South Korea (Korea), Malaysia (Malay), the Philippines (Philip), Singapore (Sing), Thailand (Thai), Taiwan (Taiwan). Method used is the EViews4 specified ML-ARCH (Marquardt) model. Robust standard errors and covariances are based on Bollerslev-Wooldrige (EViews4, 2001). In the analysis variance backcast is selected ON. SE denotes standard error. SD denotes standard deviation. Significance levels are set at 10%.

Table 2

VAR Stability Condition Check

Roots of Characteristic Polynomial	
Root	**Modulus**
0.997668 + 0.003422i	0.997674
0.997668-0.003422i	0.997674
0.089562 - 0.011023i	0.989624
0.989562 + 0.011023i	0.989624
0.983810-0.005061i	0.983823
0.983810 + 0.005061i	0.983823
0.976177	0.976177
0.964968	0.964968
0.951271	0.951271
0.927718	0.927718
0.901225	0.901225

Note: No root lies outside the unit circle.

The VAR satisfies the stability condition.

Table 3

VAR Lag Order Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-67704.70	NA	3.76E+34	110.8277	110.8736	110.8450
1	-42815.68	49289.22	9.33E+16	70.29080	70.84259*	70.49847*
2	-42678.49	269.2185	**9.08E+16***	**70.26430***	71.321990	70.66233
3	-42589.13	173.7457	9.57E+16	70.31609	71.87949	70.90448
4	-42500.05	171.6022	1.01E+17	70.36833	72.43754	71.14709
5	-42422.21	148.5345	1.08E+17	70.43897	73.01400	71.40810
6	-42343.52	148.7505	1.16E+17	70.50822	73.58905	71.66771
7	-42266.63	143.9784	1.25E+17	70.58040	74.16704	71.93025
8	-42188.91	144.1109	1.34E+17	70.65125	74.74369	72.19146
9	-42100.18	162.9823*	1.42E+17	70.70407	75.30232	72.43464
10	-42028.02	131.2205	1.54E+17	70.78399	75.88806	72.70493

Note:* indicates lag order selected by the criterion. LogL denotes log likelihood.

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 4

Johansen Cointegration Rank Test

Hypthesized No. of CE(s)	Eigen value	Trace Statistic	5 percent Critical Value	1 Percent Critical value
None **	0.082651	361.9873	277.71	293.44
At most 1 **	0.050708	255.8789	233.13	247.18
At most 2	0.033130	191.8717	192.89	204.95
At most 3	0.027724	150.4314	156.00	168.36
At most 4	0.023615	115.8496	124.24	133.57
At most 5	0.023067	86.45466	94.15	103.18
At most 6	0.017222	57.75006	68.52	76.07
At most 7	0.013818	36.32817	47.21	54.46
At most 8	0.008017	19.26742	29.68	35.65
At most 9	0.005189	9.366973	15.41	20.04
At most 10	0.002410	2.968101	3.76	6.65

Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels

Hypthesized No. of CE(s)	Eigen value	Max-Eigen Statistic	5 percent Critical Value	1 Percent Critical value
None **	0.082651	106.1084	68.83	75.95
At most 1 **	0.050708	64.00724	62.81	69.09
At most 2	0.033130	41.44032	57.12	62.80
At most 3	0.027724	34.58177	51.420	57.69
At most 4	0.023615	29.39493	45.28	51.57
At most 5	0.023067	28.70459	39.37	45.10
At most 6	0.017222	21.36789	33.46	38.77
At most 7	0.013818	17.11475	27.07	32.24
At most 8	0.008017	9.900446	20.97	25.52
At most 9	0.005189	6.398872	14.07	18.63
At most 10	0.002410	2.968101	3.76	6.65

Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level
Max-eigenvalue test indicates 1 cointegrating equation(s) at the 1% level

Note: CE denotes cointegrating equations. A linear deterministic trend is assumed.
***(**) denotes rejection of the hypothesis at the 5%(1%) level.**

Table 5

Pairwise Granger Causality Tests

Null Hypothesis	*F-Statistic*	*Probability*
JAP does not Granger Cause CHINA	**3.24712**	**0.03922**
JAP does not Granger Cause KOREA	**2.62522**	**0.07283**
MALAY does not Granger Cause JAP	5.82927	0.00302
JAP does not Granger Cause PHILIP	**2.89234**	**0.05583**
AUSTRAL does not Granger Cause CHINA	**3.01521**	**0.04940**
INDON does not Granger Cause AUSTRAL	3.45426	0.03192
AUSTRAL does not Granger Cause KOREA	**3.39322**	**0.033992**
MALAY does not Granger Cause AUSTRAL	3.11214	0.04486
PHILIP does not Granger Cause AUSTRAL	3.89650	0.02057
AUSTRAL does not Granger Cause PHILIP	**3.19423**	**0.04134**
AUSTRAL does not Granger Cause THAI	**9.71545**	**6.5E-05**
INDON does not Granger Cause CHINA	5.07913	0.00636
CHINA does not Granger Cause THAI	3.31805	0.03655
INDON does not Granger Cause HK	2.60554	0.07427
PHILIP does not Granger Cause HK	5.47463	0.00429
HK does not Granger Cause PHILIP	**4.44073**	**0.01198**
SING does not Granger Cause HK	**4.75076**	**0.00921**
HK does not Granger Cause SING	**4.10558**	**0.01671**
HK does not Granger Cause THAI	**5.90665**	**0.00280**
HK does not Granger Cause TAIWAN	**3.80427**	**0.02254**
INDON does not Granger Cause KOREA	4.29392	0.01386
SING does not Granger Cause INDON	**2.88008**	**0.05651**
INDON does not Granger Cause THAI	2.76083	0.06363
TAIWAN does not Granger Cause INDON	3.55721	0.02881
SING does not Granger Cause MALAY	**3.30429**	**0.03705**
MALAY does not Granger Cause SING	3.48095	0.03108
THAI does not Granger Cause MALAY	11.2302	1.5E-05
TAIWAN does not Granger Cause MALAY	4.95002	0.00723
THAI does not Granger Cause PHILIP	5.86050	0.00293
SING does not Granger Cause THAI	**3.54306**	**0.02922**
SING does not Granger Cause TAIWAN	**3.66302**	**0.02594**
THAI does not Granger Cause TAIWAN	5.94784	0.00269

Note: OBS denotes observations (1230 in each case). The country abbreviations have been described in the notes following Appendix Table 1. Significance levels are set at 10%. Results that are not statistically significant are not reported. Lag order is 2 days.

ABOUT THE AUTHOR

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